(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平7－30199

(43)公開日　平成７年(1995)１月31日

(51)Int.Cl.⁶	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｓ　3/18				

審査請求　未請求　請求項の数８　ＦＤ　（全　６　頁）

(21)出願番号　特願平5－348149

(22)出願日　平成５年(1993)12月25日

(31)優先権主張番号　０８／０９１７１９

(32)優先日　1993年７月14日

(33)優先権主張国　米国（ＵＳ）

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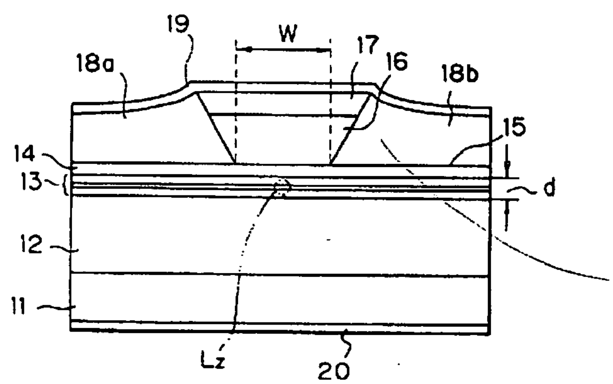
(54)【発明の名称】　半導体レーザ素子

(57)【要約】

【目的】　安定した横モードを得ることのできる半導体レーザ素子を提供する。

【構成】　リッジ型半導体レーザ素子においてレーザ動作時に基本横モードを発振させるために、厚さ（ｄ）＝０．２５～０．５０μｍの上部クラッド層１５が活性層１３の上部に残されており、底部幅（Ｗ）＝２．０～３．５μｍのリブ型クラッド層１６が活性層１３の発光領域と対応して上部クラッド層１５の上面より突出している。

【効果】　ｄおよびＷが上記の範囲内にあるので、安定した横モードを得ることができる。



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【特許請求の範囲】

【請求項１】　半導体基板の上に下部クラッド層と上部クラッド層とで覆われた活性層を備えた半導体レーザ素子において、レーザ動作時に基本横モードを発振させるために、厚さ０．２５～０．５０μｍの上部クラッド層が活性層の上部に残されているとともに、底部幅２．０～３．５μｍのリブ型クラッド層が活性層の発光領域と対応して上部クラッド層の上面より突出していることを特徴とする半導体レーザ素子。

【請求項２】　半導体基板がＧａＡｓからなる請求項１記載の半導体レーザ素子。

【請求項３】　下部クラッド層、上部クラッド層、および、リブ型クラッド層がそれぞれＩｎＧａＰからなる請求項１記載の半導体レーザ素子。

【請求項４】　活性層がＩｎＧａＡｓ歪量子井戸層からなる請求項１記載の半導体レーザ素子。

【請求項５】　活性層がＳＣＨ構造を含んでいる請求項１記載の半導体レーザ素子。

【請求項６】　活性層がＧＲＩＮ－ＳＣＨ構造を含んでいる請求項１記載の半導体レーザ素子。

【請求項７】　活性層がＱＷ構造を含んでいる請求項１記載の半導体レーザ素子。

【請求項８】　活性層がＭＱＷ構造を含んでいる請求項１記載の半導体レーザ素子。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、光通信、光増幅、光計測などの光技術分野において、波長０．９～１．１μｍ帯の光源として用いることのできる半導体レーザ素子に関する。

【０００２】

【従来の技術】波長０．９～１．１μｍ帯の光源として期待されている半導体レーザ素子の一つに、ＧａＡｓ半導体基板上の活性層がＩｎＧａＡｓ歪量子井戸層からなるものがある。この半導体レーザ素子の場合、希土類イオンがドープされた光増幅ファイバの励起光源として実用化が進められているほか、非線型光学素子と組み合わされる０．４５～０．５５μｍ帯の短波長光源としても実用化が進められている。これらのうち、最も実用化が近いとされているのは、エルビウムイオンをドープされた光増幅ファイバ（波長１．５μｍ帯）用の励起光源（波長０．９８μｍ帯）である。

【０００３】上述した半導体レーザ素子と光ファイバのような小口径の光導波路とは、半導体レーザ素子から出射した数十ミリワットの高出力を光導波路に入射させるために、これらが光学的に結合される。この場合の半導体レーザ素子は、安定した単峰性の出射ビームすなわち基本横モードを発振するものでなければならない。基本横モード発振させるためのレーザ構造としては、種々のものがすでに提案されており、ＩｎＧａＡｓ歪量子井戸

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型の半導体レーザ素子においては、リッジ型レーザ構造がよく用いられる。上記においてリッジ型レーザ構造が多用される理由は、歪の入った活性層を露出させたり、露出した活性層を他の半導体層で埋めこむ必要がなく、既述の用途に適しているからである。

【０００４】最近、ＩｎＧａＡｓ歪量子井戸型の半導体レーザ素子において、ＡｌＧａＡｓクラッド層に代え、ＩｎＧａＰクラッド層を用いた報告例が多くみられる。この半導体レーザ素子においてＩｎＧａＰクラッド層を用いた場合の利点は、下記の文献１～４に詳しく記載されており、このようなクラッド層をもつ半導体レーザ素子も、特開平３－２２２４８８号公報に開示されている。

文献１：J. P. Wittkc and I. Ladany, J. Appl. phys., 48(1977)3122.

文献２：J. Buns, IEEE J-QE QE-19(1983)953.

文献３：T. Ohtoshi et al., Solid-State Electron., 30(1987)627.

文献４：R. Lang, IEEE J-QE QE-15(1979)718-726.

これらの文献から明らかなように、ＩｎＧａＰクラッド層をもつＩｎＧａＡｓ歪量子井戸型半導体レーザ素子の場合は、ＩｎＧａＰとＩｎＧａＡｓとをきわめて高い選択比でウエットエッチングすることができる。したがって、かかるレーザ素子をつくるとき、ＩｎＧａＰクラッド層の一部に極薄膜のＧａＡｓ層を挿入しておき、その上部のＩｎＧａＰクラッド層を選択的にエッチングすることにより、高精度のリッジ型レーザ構造が得られる。

【０００５】図１は上記に基づいて作製された半導体レーザ素子の一例を示している。かかる半導体レーザ素子の場合は、ｎ－ＧａＡｓ半導体基板１１上において、ｎ－ＩｎＧａＰ下部クラッド層１２と、ＩｎＧａＡｓ歪量子井戸層からなる活性層１３と、ＧａＡｓエッチングストップ層１４と、ｐ－ＩｎＧａＰ上部クラッド層１５と、リッジ用のｐ－ＩｎＧａＰリブ型クラッド層１６と、ｐ－ＧａＡｓコンタクト層１７と、ポリイミド樹脂クラッド層１８ａ、１８ｂとが順次形成されたものである。上記において、金属導体製のｐ電極１９はコンタクト層１７から樹脂クラッド層１８ａ、１８ｂにわたる上面に設けられており、金属導体製のｎ電極２０は半導体基板１１の下面に設けられている。

【０００６】

【発明が解決しようとする課題】図１に例示された半導体レーザ素子の場合、その発光領域L_zから出射されるビームの水平横モード（ＦＦＰ‖）、垂直横モード（ＦＦＰ⊥）が図３のような分布を呈する。このような半導体レーザ素子において単峰性の出射ビームを得ようとするときは、リッジたるリブ型クラッド層１６の底部幅Ｗを小さくするのが有効であるとされている。ちなみに、Ｗ＝３μｍの場合は図６（ａ）のごとく基本横モード発振するが、Ｗ＝６μｍの場合は、図６（ｂ）のごとく高

次モードが発生するために、これと小口径光導波路とを集光レンズにより結合するのが困難になる。単峰性の横モードを得るためのWの値（Wc）が水平方向の屈折率分布により変化することは、この種の技術分野で知られており、リッジとその他部との実効屈折率差が1%以下であるリッジ型レーザ構造の場合は、W＜4μmにおいて単峰性横モードが得られる。しかし、リッジ型レーザ構造において、レーザ構成材料の発振波長に対応する屈折率を用いてWcの値を計算することは、これが可能であるとしても実際的には容易でなく、その計算値の妥当性も問題になる。

【0007】さらに、図1のごとき半導体レーザ素子においては、閾値電流を注入した直後に単峰性のビームが得られたとしても、その後の注入電流が増すことにより水平横モードが変化する。これは本発明者らの実験において判明した事象であり、この際の実験では、図1の半導体レーザ素子として、つぎのような仕様のものが用いられた。p－InGaP上部クラッド層15は、これの厚さdが0．2μmをわずかに下回り、p－InGaPリブ型クラッド層16は、これの底部幅Wが3．5μmとなっている。共振器長は1000μmであり、後部共振器ミラーとして反射率95%のコーティング反射膜が用いられ、前部共振器ミラーとして反射率10%のコーティング反射膜が用いられた。

【0008】図8（a）、図8（b）は上記実験例における半導体レーザ素子の水平横モード（FFP∥）、垂直横モード（FFP⊥）について、これらの電流依存特性を示したものである。かかる半導体レーザ素子の場合、出射ビームの単峰性を保持しながらも、注入電流110～140mA間において、ビームの中心が図8（a）のように約5度変化している。図7は上記実験例における半導体レーザ素子の光出力－電流（I－L）特性図である。図7において、実線はフリースペースでのI－Lを示し、点線は、当該半導体レーザ素子と光導波路（コア直径8μmφの光ファイバ）とが水平および垂直の2レンズ系を介して結合された場合の光ファイバ端の出力を示している。図8を参照して明らかなように、上記実験例の半導体レーザ素子は、フリースペースでも水平横モードの変化にともなってキンクがあらわれ、しかも、光ファイバ端の出力までが水平横モードの変化後に大きく低下している。これはレンズ集光した像が水平横モードの変化に起因して動き、半導体レーザ素子と光導波路との結合効率が低下したからである。ゆえに、この種の半導体レーザ素子として、閾値電流の注入直後はもちろんのこと、その後に注入電流を増した場合でも水平横モードの単峰性を保持することができ、かつ、ビーム中心の動かないものが要求される。

【0009】［発明の目的］本発明はこのような技術的課題に鑑み、安定した横モードを得ることのできる半導体レーザ素子を提供しようとするものである。

【0010】

【課題を解決するための手段】本発明は、半導体基板の上に下部クラッド層と上部クラッド層とで覆われた活性層を備えた半導体レーザ素子において、レーザ動作時に基本横モードを発振させるために、厚さ0．25～0．50μmの上部クラッド層が活性層の上部に残されているとともに、底部幅2．0～3．5μmのリブ型クラッド層が活性層の発光領域と対応して上部クラッド層の上面より突出していることを特徴として、所期の目的を達成する。

【0011】上記における一例として、半導体基板はGaAsからなり、下部クラッド層と上部クラッド層とリブ型クラッド層は、それぞれInGaPからなる。上記における一例として、活性層はInGaAs歪量子井戸層からなる。この場合の活性層は、SCH構造、GRIN－SCH構造のいずれか、および／または、QW構造、MQW構造のいずれかを含んでいることがある。

【0012】

【作用】周知のとおり、リッジ型レーザ構造をもつ半導体レーザ素子においては、注入電流の増加にともなって光出力が増大するときに、活性層内のキャリアが消費されるが、これに際して、フーリエ変化である水平横モードが変化する。これの原因としては、光密度の高いメサ中央部において特にキャリアが減少しやすく、その両側での利得が高くなるためにホールバーニングが生じること、および、このような利得分布の変化にともない、高次モードが励起されて光密度分布が変化することが考えられる。

【0013】本発明に係る半導体レーザ素子は、厚さ0．25～0．50μmの上部クラッド層が活性層の上部に残されており、底部幅2．0～3．5μmのリブ型クラッド層が活性層の発光領域と対応して上部クラッド層の上面より突出している。

【0014】上部クラッド層の厚さが0．25～0．50μmの場合、これが水平方向の実効屈折率差を減少させることとなり、高次モードがカットオフされやすくなるので、光密度が減少し、ホールバーニングも起こりがたくなる。

【0015】リブ型クラッド層の底部幅が2．0～3．5μmの場合、高次モードがカットオフになるだけでなく、キャリアの消費に対して拡散によるキャリアの注入が追従するために、ホールバーニングが起こりがたくなる。したがって、本発明に係る半導体レーザ素子の場合は、水平横モードが変化せず、安定した横モードを得ることができる。

【0016】

【実施例】本発明に係る半導体レーザ素子の基本的な構成は、図1に例示されたものと同様である。すなわち、本発明に係る半導体レーザ素子は、n－GaAs半導体基板11上において、n－InGaP下部クラッド層1

２と、ＩｎＧａＡｓ歪量子井戸層からなる活性層１３と、ＧａＡｓエッチングストップ層１４と、ｐ－ＩｎＧａＰ上部クラッド層１５と、ｐ－ＩｎＧａＰリブ型クラッド層１６と、ｐ－ＧａＡｓコンタクト層１７と、ポリイミド樹脂クラッド層１８ａ、１８ｂとが順次形成されてたものであり、かつ、コンタクト層１７から樹脂クラッド層１８ａ、１８ｂにわたる上面には金属導体製のｐ電極１９が設けられ、半導体基板１１の下面には金属導体製のｎ電極２０が設けられている。上記における活性層１３は、図２を参照して明らかなように、ＩｎＧａＰからなるＧＲＩＮ－ＳＣＨ構造１３ａ、１３ｂを含んでいる。

【００１７】本発明に係る半導体レーザ素子は、既述のとおり、上部クラッド層１５の厚さｄが０．２５～０．５０μｍの範囲内にあり、リブ型クラッド層１６の底部幅Ｗが２．０～３．５μｍの範囲内にある。ちなみに、＊ｄ＝０．３μｍ、Ｗ＝２．７μｍである半導体レーザ素子の水平横モードについて、これの電流依存特性を示すと図４のようになる。ｄ＝０．３μｍ、Ｗ＝２．７μｍの半導体レーザ素子は、図４を参照して明らかなように、これのビームが単峰性を保持しており、ビームの中心も変動していない。

【００１８】つぎに、本発明に係る半導体レーザ素子の有効性を確認するための実験例について説明する。下記の表は、図１のごとき半導体レーザ素子として、ｄとＷとをパラメータにして種々のものをつくり、それぞれ評価素子数５０以上においてビームの安定した半導体レーザ素子が得られる確率、より具体的には、注入電流２００ｍＡまでにおいてビーム中心に変動のない素子が得られる確率を示したものである。

【００１９】

W＼d	0.10μm	0.15μm	0.20μm	0.25μm	0.30μm
2.0μm	0.05	0.05	0.20	0.80	0.75
2.5μm	～0	～0	0.05	0.80	0.80
3.0μm	～0	～0	～0	0.50	0.60
3.5μm	－－	－－	～0	0.30	0.40
4.0μm	－－	－－	－－	0.10	0.10

【００２０】上記の表を参照して明らかなように、ｄ＞０．２５μｍ、Ｗ≦３．５μｍを満足させる半導体レーザ素子の場合は、高い確率で安定した横モードを得ることができる。

【００２１】本発明に係る半導体レーザ素子は、エピタキシャル成長法のごとき結晶成長技術、メサ形成のための選択エッチング工程を含むフォトリソグラフィ技術などを利用して作製することができる。この場合、結晶成長の膜厚制御レベル（±３％程度）でｄを制御することができ、かつ、フォトマスクの制度レベル（±０．１μｍ程度）でＷを制御することができるために、前記表に示すデータの信頼性は高い。

【００２２】図５は本発明に係る半導体レーザ素子のＩ－Ｌ特性図であり、実線はフリースペースでのＩ－Ｌを示し、点線は、前記図７で述べたと同様、光ファイバ端の出力を示している。図５を参照して明らかなように、本発明に係る半導体レーザ素子は、フリースペース、光ファイバ端とも、キンクがあらわれておらず、半導体レーザ素子と光ファイバとの高結合状態が得られている。

【００２３】本発明に係る半導体レーザ素子は、図１に例示されたものに限定されない。たとえば、活性層がＳＣＨ構造、ＭＱＷ構造を含む半導体レーザ素子でも、本発明の技術は有効である。その他、本発明半導体レーザ素子におけるクラッド層１８ａ、１８ｂは、絶縁体（誘電体）でＩｎＧａＰよりも屈折率が小さいものであれば、ポリイミド樹脂以外のものも採用することができる。これの具体例として、SiO_2、SiN_x、Al_2O_3、合成樹脂一般、さらに、ＡｌＩｎＧａＰのごとき化合物半導体をあげることができる。

【００２４】

【発明の効果】本発明は、リッジ型半導体レーザ素子においてレーザ動作時に基本横モードを発振させるために、厚さ０．２５～０．５０μｍの上部クラッド層が活性層の上部に残されているとともに、底部幅２．０～３．５μｍのリブ型クラッド層が活性層の発光領域と対応して上部クラッド層の上面より突出しているから、安定した横モードを得ることができる。

【図面の簡単な説明】

【図１】本発明半導体レーザ素子の一実施例を示した断面図である。

【図２】本発明半導体レーザ素子における活性層のＧＲＩＮ－ＳＣＨ構造を、これのバンドギャップエネルギ、膜厚と共に略示した図である。

【図３】本発明半導体レーザ素子におけるレーザビームの横モード分布図である。

【図４】本発明半導体レーザ素子における水平横モード

の電流依存特性図である。

【図５】本発明半導体レーザ素子の光出力－電流特性図である。

【図６】W＝３μm、W＝６μmの各半導体レーザ素子について、閾値電流注入直後の水平横モードを示した図である。

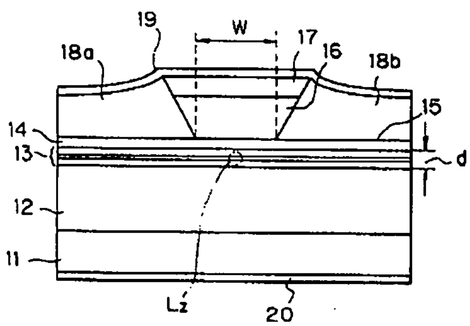
【図７】既存の半導体レーザ素子における光出力－電流特性図である。

【図８】既存の半導体レーザ素子における水平横モード、垂直横モードについて、これらの電流依存特性を示した図である。

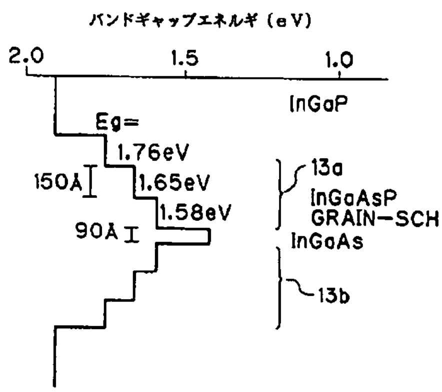
【符号の説明】

＊１１　半導体基板
１２　下部クラッド層
１３　活性層
１４　エッチングストップ層
１５　上部クラッド層
１６　リブ型クラッド層
１７　コンタクト層
１８ａ　樹脂クラッド層
１８ｂ　樹脂クラッド層
１９　ｐ電極
２０　ｎ電極
＊

【図１】



【図２】



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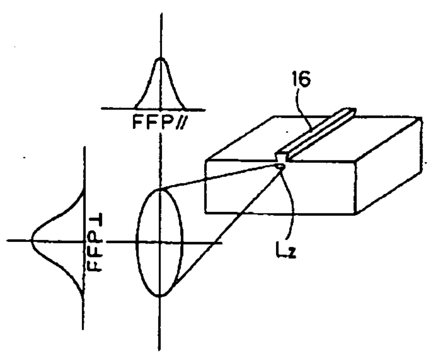

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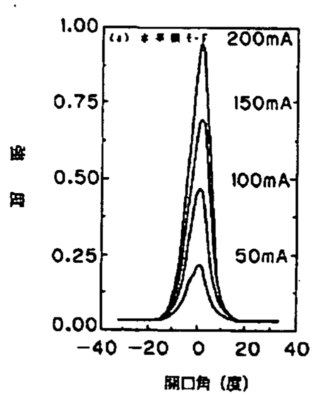

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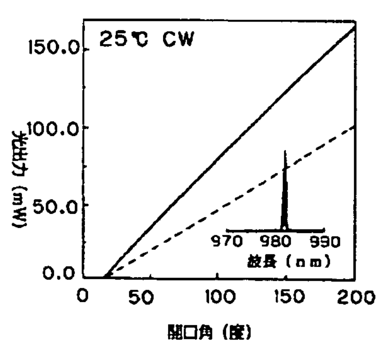

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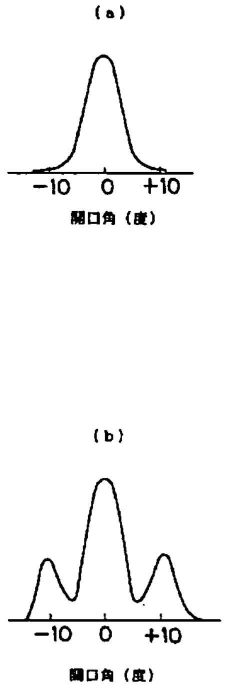

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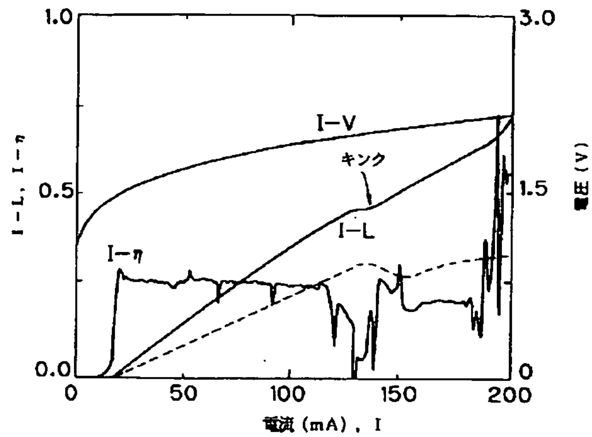
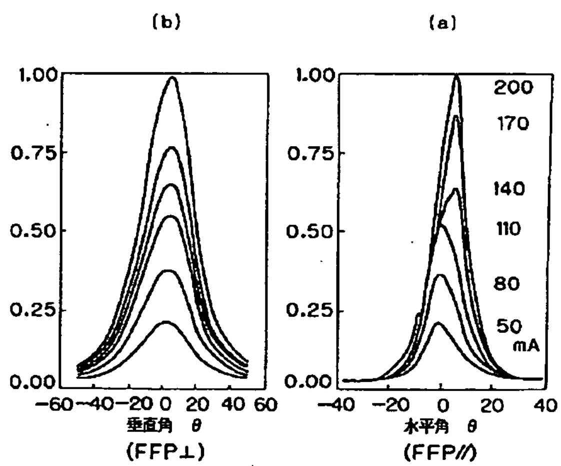


【図8】



フロントページの続き

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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-030199 B3

(43)Date of publication of application : 31.01.1995

(51)Int.Cl. H01S 3/18

(21)Application number : 05-348149

(22)Date of filing : 25.12.1993

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(30)Priority

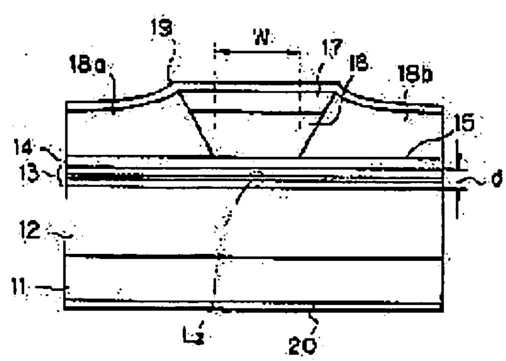
Priority number : 93 91719 Priority date : 14.07.1993 Priority country : US

(54) SEMICONDUCTOR LASER ELEMENT

(57)Abstract:

PURPOSE: To provide a semiconductor laser element which can obtain a stable side mode.

CONSTITUTION: For oscillating a basic side mode on laser operation in a ridge- type semiconductor laser element, an upper clad layer 15 with a thickness (d) =0.25-0.50μm is left on the upper part of an active layer 13 and a rib-type clad layer 16 with a bottom width of (W)=2.0-3.5μm protrudes from the upper surface of the upper clad layer 15 corresponding to the light emission region of the active layer 13, thus obtaining a stable side mode since d and W are within the above range.



LEGAL STATUS

[Date of request for examination]	30.10.1998
[Date of sending the examiner's decision of rejection]	13.06.2000
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

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CLAIMS
[Claim(s)]

[Claim 1] The semiconductor laser element characterized by the rib type clad layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers having projected from the

top of an up clad layer corresponding to the photogenesis field of a barrier layer while the up clad layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer in the semiconductor laser element equipped with the barrier layer covered in the lower clad layer and the up clad layer on the semiconductor substrate, in order to oscillate the basic transverse mode at the time of a laser operation.

[Claim 2] The semiconductor laser element according to claim 1 which a semiconductor substrate becomes from GaAs.

[Claim 3] The semiconductor laser element according to claim 1 which a lower clad layer, an up clad layer, and a rib type clad layer become from InGaP, respectively.

[Claim 4] The semiconductor laser element according to claim 1 which a barrier layer becomes from InGaAs deformation amount child well layer.

[Claim 5] The semiconductor laser element according to claim 1 in which the barrier layer includes SCH structure.

[Claim 6] The semiconductor laser element according to claim 1 in which the barrier layer includes GRIN-SCH structure.

[Claim 7] The semiconductor laser element according to claim 1 in which the barrier layer includes QW structure.

[Claim 8] The semiconductor laser element according to claim 1 in which the barrier layer includes MQW structure.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001] [Field of the Invention] this invention relates to the semiconductor laser element which can be used as light source of wavelength the band of 0.9-1.1 micrometers in opto-electronics fields, such as optical communication, an optical amplification, and optical instrumentation.

[0002] [Description of the Prior Art] There are some to which the barrier layer on GaAs semiconductor substrate becomes one of the semiconductor laser elements expected as light source of wavelength the band of 0.9-1.1 micrometers from InGaAs deformation amount child well layer. In the case of this semiconductor laser element, utilization is advanced as excitation light source of the optical amplification fiber with which rare earth ion was doped, and also utilization is advanced as short wavelength light source of 0.45-0.55 micrometer band combined with a non-line type optical element. Among these, it is supposed the excitation light source (wavelength band of 0.98 micrometers) for optical amplification fibers (wavelength band of 1.5 micrometers) which had erbium ion doped that utilization is the nearest.

[0003] In order for the semiconductor laser element mentioned above and an optical waveguide of the diameter of the microstomia like an optical fiber to carry out incidence of the mW [some dozens of] high power which carried out the outgoing radiation from the semiconductor laser element to an optical waveguide, these are combined optically. The semiconductor laser element in this case must oscillate, stable outgoing-radiation beam, i.e., basic transverse mode, of single ****. As laser structure for carrying out a basic transverse-mode oscillation, various things are already proposed and ridge type laser structure is well used in an InGaAs deformation amount child well type semiconductor laser element. It is not

necessary to expose the barrier layer which was oval or to embed the exposed barrier layer in other semiconductor layers, and the ground ridge type laser structure is used abundantly in the above is suitable for intended use as stated above.

[0004] Recently, in an InGaAs deformation amount child well type semiconductor laser element, it replaces with AlGaAs clad layer and many examples of a report using InGaP clad layer are seen. It is indicated in detail by the reference 1-4 of the following [advantage / at the time of using InGaP clad layer in this semiconductor laser element], and the semiconductor laser element with such a clad layer is also indicated by JP,3-222488,A. Reference 1:J.P.Wittkc and I.Ladany and J.Appl. phys. and 48 (1977) 3122. reference 2:J. Buns, IEEE J-QE QE-19 (1983) 953. reference 3:T.Ohtoshi et al., Solid-State Electron., and 30 (1987) 627. reference 4:R.Lang, IEEE J-QE QE-15 (1979) 718-726. -- so that clearly from these reference In the case of InGaAs deformation amount child well type semiconductor laser element with InGaP clad layer, wet etching of InGaP and the InGaAs can be carried out by the very high selection ratio. Therefore, when building such a laser element, GaAs layer of an ultra-thin layer is inserted in a part of InGaP clad layer, and highly precise ridge type laser structure is acquired by etching InGaP clad layer of the upper part alternatively.

[0005] Drawing 1 shows an example of the semiconductor laser element produced based on the above. In the case of such a semiconductor laser element, the n-InGaP lower clad layer 12, the barrier layer 13 which consists of an InGaAs deformation amount child well layer, GaAs etching stop layer 14, the p-InGaP up clad layer 15, the p-InGaP rib type clad layer 16 for ridges, the p-GaAs contact layer 17, and the polyimide-resin clad layers 18a and 18b are formed one by one on the n-GaAs semiconductor substrate 11. In the above, the p electrode 19 made from a metallic conductor is formed in the top covering the resin clad layers 18a and 18b from the contact layer 17, and the n electrode 20 made from a metallic conductor is formed in the inferior surface of tongue of the semiconductor substrate 11.

[0006] [Problem(s) to be Solved by the Invention] the case of the semiconductor laser element illustrated in drawing 1 -- the photogenesis field LZ **** -- the level transverse mode (FFP||) of the beam by which an outgoing radiation is carried out, and the perpendicular transverse mode (FFP**) present a distribution as shown in drawing 3 When it is going to obtain the outgoing-radiation beam of single **** in such a semiconductor laser element, to make small pars-basilaris-ossis-occipitalis width-of-face W of the ridge slack rib type clad layer 16 is confirmed. Incidentally, although the basic transverse-mode oscillation of the W= 3-micrometer case is carried out as shown in drawing 6 (a), as shown in drawing 6 (b), in order that the higher mode may occur in W= 6 micrometers, it becomes difficult to combine this and the diameter optical waveguide of the microstomia by the condenser lens. It is known for this kind of technical field that the value (Wc) of W for obtaining the transverse mode of single **** will change with horizontal refractive-index distributions, and when it is a ridge and the ridge type laser structure where the effective-refractive-index difference with the section is 1% or less in addition to this, the single **** transverse mode is obtained in W< 4 micrometers. However, in ridge type laser structure, it is not easy to calculate the value of Wc using the refractive index corresponding to the oscillation wavelength of a laser component in practice, though this is possible, and the validity of the calculated value also becomes a problem.

[0007] Furthermore, in the semiconductor laser element like drawing 1 , though the beam of single **** is obtained immediately after pouring in a threshold current, when a subsequent inrush current increases, the level transverse mode changes. This is the event made clear in the experiment of this invention persons, and the thing of the following specifications was used as a semiconductor laser element of drawing 1 in the experiment in this case. The p-

InGaP up clad layer 15 is slightly [thickness d of this / 0.2 micrometers] less, and, as for the p-InGaP rib type clad layer 16, pars-basilaris-ossis-occipitalis width-of-face W of this has become 3.5 micrometers. The cavity length was 1000 micrometers, as a posterior-part resonator mirror, the coating reflective layer of 95% of reflection factors was used, and the coating reflective layer of 10% of reflection factors was used as a pars-anterior resonator mirror.

[0008] Drawing 8 (a) and the drawing 8 (b) show these current dependence properties about the level transverse mode (FFP||) of the semiconductor laser element in the above-mentioned example of an experiment, and the perpendicular transverse mode (FFP**). As shown in drawing 8 (a), though the single **** of an outgoing-radiation beam is held in the case of such a semiconductor laser element, the center of a beam is changing about 5 degrees between 110-140mA of inrush currents. Drawing 7 is an optical-output-current (I-L) property view of a semiconductor laser element in the above-mentioned example of an experiment. In drawing 7 , a solid line shows I-L in a free space, and the dotted line shows the output of an optical fiber edge when a concerned semiconductor laser element and a concerned optical waveguide (optical fiber of core diameter [of 8 micrometers] phi) are combined through horizontal and vertical 2 lens systems. With reference to drawing 8 , as for the semiconductor laser element of the above-mentioned example of an experiment, a kink appears in connection with change of the level transverse mode also in a free space, and, moreover, even the output of an optical fiber edge is declining greatly after change of the level transverse mode so that clearly. This is because the image which carried out lens condensing originated and moved to change of the level transverse mode and the joint luminous efficacy of a semiconductor laser element and an optical waveguide fell. Therefore, that to which the single **** of the level transverse mode can be held even when an inrush current is increased after that not to mention immediately after injection of a threshold current, and a beam center does not move as this kind of a semiconductor laser element is demanded.

[0009] The [purpose of invention] this invention tends to offer the semiconductor laser element which can obtain the stable transverse mode in view of such a technical problem.

[0010] [Means for Solving the Problem] In the semiconductor laser element equipped with the barrier layer covered in the lower clad layer and the up clad layer on the semiconductor substrate, in order to oscillate the basic transverse mode at the time of a laser operation, this invention While the up clad layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer, it is characterized by the rib type clad layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers having projected from the top of an up clad layer corresponding to the photogenesis field of a barrier layer, and the desired end is attained.

[0011] As an example in the above, a semiconductor substrate consists of GaAs and a lower clad layer, an up clad layer, and a rib type clad layer consist of InGaP, respectively. A barrier layer consists of an InGaAs deformation amount child well layer as an example in the above. The barrier layer in this case may include SCH structure or GRIN-SCH structure and/or QW structure, or MQW structure.

[0012] [Function] Although the carrier in a barrier layer is consumed in the semiconductor laser element with ridge type laser structure as everyone knows when an optical output increases in connection with the increase in an inrush current, in case of this, the level transverse mode which is Fourier change changes. Since carriers tend to decrease in number especially in the mesa center section where an optical density is high and the gain in the both

sides becomes high as a cause of this, it can consider the thing which a hole burning produces, and that the higher mode is excited and optical density distribution changes in connection with change of such a gain distribution.

[0013] The up clad layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer, and the rib type clad layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers has projected the semiconductor laser element concerning this invention from the top of an up clad layer corresponding to the photogenesis field of a barrier layer.

[0014] When an up clad layer thickness is 0.25-0.50 micrometers, this makes a horizontal effective-refractive-index difference decrease, since the higher mode becomes is easy to be cut off, an optical density decreases, and a hole burning seldom comes to happen, either.

[0015] Since the higher mode is not only cut off, but injection of the carrier by diffusion follows to a consumption of a carrier when the pars-basilaris-ossis-occipitalis width of face of a rib type clad layer is 2.0-3.5 micrometers, a hole burning seldom comes to happen. Therefore, in the case of the semiconductor laser element concerning this invention, the level transverse mode cannot change but the stable transverse mode can be obtained.

[0016] [Example] The fundamental configuration of the semiconductor laser element concerning this invention is the same as that of what was illustrated in drawing 1 . Namely, the semiconductor laser element concerning this invention In the n-GaAs semiconductor substrate 11 top The n-InGaP lower clad layer 12, The barrier layer 13 which consists of an InGaAs deformation amount child well layer, and GaAs etching stop layer 14, The p-InGaP up clad layer 15 and the p-InGaP rib type clad layer 16, The p-GaAs contact layer 17 and polyimide-resin clad layer 18a, 18b is formed one by one, it is **, and the p electrode 19 made from a metallic conductor is formed in the top covering the resin clad layers 18a and 18b from the contact layer 17, and the n electrode 20 made from a metallic conductor is formed in the inferior surface of tongue of the semiconductor substrate 11 With reference to drawing 2 , the barrier layer 13 in the above includes the GRIN-SCH structures 13a and 13b which consist of InGaP so that clearly.

[0017] As stated above, the semiconductor laser element concerning this invention is in within the limits whose thickness d of the up clad layer 15 is 0.25-0.50 micrometers, and is in within the limits whose pars-basilaris-ossis-occipitalis width-of-face W of the rib type clad layer 16 is 2.0-3.5 micrometers. Incidentally, about the level transverse mode of the semiconductor laser element which are d= 0.3 micrometers and W= 2.7 micrometers, if the current dependence property of this is shown, it will become as it is shown in drawing 4 . As for a semiconductor laser element (d= 0.3 micrometers and W= 2.7 micrometers), the beam of this holds single **** so that clearly with reference to drawing 4 , and the center of a beam is not changed, either.

[0018] The example of an experiment for next checking the effectiveness of the semiconductor laser element concerning this invention is explained. As a semiconductor laser element like drawing 1 , the following table makes d and W a parameter, builds various things, and shows the probability from which the semiconductor laser element by which the beam was stabilized in 50 or more evaluation element numbers, respectively is obtained, and the probability from which the element which sets by 200mA of inrush currents, and does not more specifically have change in a beam center is obtained.

[0019] W**d 0.10 micrometers 0.15 micrometers 0.20 micrometers 0.25 micrometers 0.30 micrometers 2.0 micrometers 0.05 0.05 0.20 0.80 0.75 2.5 micrometers - 0 - 0 0.05 0.80 0.80

3.0micrometer- 0 - 0 - 0 0.500.60 3.5 micrometers -- -- - 0 0.30 0.40 It is -- 4.0 micrometers. - - -- 0.10 0.10

[0020] With reference to the above-mentioned table, in the case of the semiconductor laser element for which d> 0.25 micrometers and W<=3.5 micrometers are satisfied, the transverse mode stabilized by the high probability can be obtained so that clearly.

[0021] The semiconductor laser element concerning this invention is producible using the photolithography technique containing the selection etching process for the crystal-growth technique like an epitaxial grown method, and mesa formation etc. In this case, since d can be controlled by thickness-control level (about **3%) of a crystal growth and W can be controlled by system level (about **0.1 micrometers) of a photo mask, the reliability of the data shown in the aforementioned table is high.

[0022] Drawing 5 is an I-L property view of the semiconductor laser element concerning this invention, a solid line shows I-L in a free space, and the dotted line shows the output of an optical fiber edge that the aforementioned view 7 described similarly. With reference to drawing 5 , a kink does not appear but, as for the semiconductor laser element concerning this invention, the high integrated state of a semiconductor laser element and an optical fiber is obtained for the free space and the optical fiber edge so that clearly.

[0023] The semiconductor laser element concerning this invention is not limited to what was illustrated in drawing 1 . For example, the technique of this invention is effective also with the semiconductor laser element in which a barrier layer includes SCH structure and MQW structure. In addition, with an insulator (dielectric), rather than InGaP, if a refractive index is a parvus thing, things other than a polyimide resin can also be used for the clad layers 18a and 18b in this invention semiconductor laser element. As an example of this, the compound semiconductor like AlInGaP can be raised to SiO2, SiNx, aluminum2 O3, general synthetic resin, and a pan.

[0024] [Effect of the Invention] Since the rib type clad layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers has projected this invention from the top of an up clad layer corresponding to the photogenesis field of a barrier layer while the up clad layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer in order to oscillate the basic transverse mode in a ridge type semiconductor laser element at the time of a laser operation, it can obtain the stable transverse mode.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the cross section having shown one example of this invention semiconductor laser element.

[Drawing 2] It is drawing which ****ed the GRIN-SCH structure of the barrier layer in this invention semiconductor laser element with the band-gap energy of this, and the thickness.

[Drawing 3] It is the transverse-mode distribution map of a laser beam in this invention semiconductor laser element.

[Drawing 4] It is the current dependence property view of the level transverse mode in this invention semiconductor laser element.

[Drawing 5] It is the optical-output-current characteristic view of this invention semiconductor laser element.

[Drawing 6] It is drawing having shown the level transverse mode immediately after threshold-current injection about each semiconductor laser element (W= 3 micrometers and W= 6 micrometers).

[Drawing 7] It is an optical-output-current characteristic view in the existing semiconductor laser element.

[Drawing 8] It is drawing having shown these current dependence properties about the level transverse mode and the perpendicular transverse mode in the existing semiconductor laser element.

[Description of Notations]
11 Semiconductor Substrate
12 Lower Clad Layer
13 Barrier Layer
14 Etching Stop Layer
15 Up Clad Layer
16 Rib Type Clad Layer
17 Contact Layer
18a Resin clad layer
18b Resin clad layer
19 P Electrode
20 N Electrode

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CONSTITUTION: For oscillating a basic side mode on laser operation in a ridge- type semiconductor laser element, an upper clad layer 15 with a thickness (d)=0.25-0.50μm is left on the upper part of an active layer 13 and a rib-type clad layer 16 with a bottom width of (W)=2.0-3.5μm protrudes from the upper surface of the upper clad layer 15 corresponding to the light emission region of the active layer 13, thus obtaining a stable side mode since d and W are within the above range.

CLAIMS

[Claim(s)]
[Claim 1] The semiconductor laser component characterized by the rib mold cladding layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers having projected from the top face of an up cladding layer corresponding to the luminescence field of a barrier layer while the up cladding layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer in the semiconductor laser component equipped with the

barrier layer covered by the lower cladding layer and the up cladding layer on the semi-conductor substrate , in order to oscillate the basic transverse mode at the time of laser actuation.

[Claim 2] The semiconductor laser component according to claim 1 which a semi-conductor substrate becomes from GaAs.

[Claim 3] The semiconductor laser component according to claim 1 which a lower cladding layer, an up cladding layer, and a rib mold cladding layer become from InGaP, respectively.
[Claim 4] The semiconductor laser component according to claim 1 which a barrier layer becomes from an InGaAs deformation amount child well layer.

[Claim 5] The semiconductor laser component according to claim 1 in which the barrier layer includes SCH structure.

[Claim 6] The semiconductor laser component according to claim 1 in which the barrier layer includes GRIN-SCH structure.

[Claim 7] The semiconductor laser component according to claim 1 in which the barrier layer includes QW structure.

[Claim 8] The semiconductor laser component according to claim 1 in which the barrier layer includes MQW structure.

DETAILED DESCRIPTION
[Detailed Description of the Invention]

[0001] [Industrial Application] This invention relates to the semiconductor laser component which can be used as the light source of a wavelength the band of 0.9-1.1 micrometers in the opto-electronics fields, such as optical communication, optical amplification, and optical measurement.

[0002] [Description of the Prior Art] There are some to which the barrier layer on a GaAs semi-conductor substrate is set to one of the semiconductor laser components expected as the light source of a wavelength the band of 0.9-1.1 micrometers from an InGaAs deformation amount child well layer. In the case of this semiconductor laser component, utilization is advanced as the excitation light source of the optical amplification fiber with which rare earth ion was doped, and also utilization is advanced as a source of short wave Nagamitsu of 0.45-0.55-micrometer band combined with a nonlinear optical element. It is supposed the excitation light source (wavelength band of 0.98 micrometers) for optical amplification fibers (wavelength band of 1.5 micrometers) which had erbium ion doped that utilization is among these the nearest.

[0003] In order for the semiconductor laser component mentioned above and the optical waveguide of small aperture like an optical fiber to carry out incidence of the dozens of mW high power which carried out outgoing radiation from the semiconductor laser component to optical waveguide, these are combined optically. The semiconductor laser component in this case must oscillate, stable monophasic outgoing radiation beam, i.e., basic transverse mode. As laser structure for carrying out a basic transverse-mode oscillation, various things are already proposed and ridge mold laser structure is well used in the semiconductor laser component of an InGaAs deformation amount child well mold. It is not necessary expose the distorted barrier layer or to embed the exposed barrier layer in other semi-conductor layers, and the reason ridge mold laser structure is used abundantly in the above is suitable for the application as stated above.

[0004] Recently, in the semiconductor laser component of an InGaAs deformation amount child well mold, it replaces with an AlGaAs cladding layer and many examples of a report using an InGaP cladding layer are seen. The advantage at the time of using an InGaP cladding layer in this semiconductor laser component is indicated in detail by the following reference 1-4, and the semiconductor laser component with such a cladding layer is also indicated by JP,3-222488,A. Reference 1:J.P.Wittkc and I.Ladany and J.Appl. phys. and 48 (1977) 3122. reference 2:J. Buns and IEEE J-QE QE-19 (1983) 953. reference 3:T.Ohtoshi et al., Solid-State Electron., and 30 (1987) 627. reference 4:R.Lang, IEEE J-QE QE-15 (1979) 718-726. -- so that clearly from these reference In the case of an InGaAs deformation amount child well mold semiconductor laser component with an InGaP cladding layer, wet etching of InGaP and the InGaAs can be carried out by the very high selection ratio. Therefore, when building this laser component, highly precise ridge mold laser structure is acquired by inserting the GaAs layer of the ultra-thin film in a part of InGaP cladding layer, and etching the InGaP cladding layer of the upper part alternatively.

[0005] Drawing 1 shows an example of the semiconductor laser component produced based on the above. In the case of this semiconductor laser component, sequential formation of the n-InGaP lower cladding layer 12, the barrier layer 13 which consists of an InGaAs deformation amount child well layer, the GaAs etching stop layer 14, the p-InGaP up cladding layer 15, the p-InGaP rib mold cladding layer 16 for ridges, the p-GaAs contact layer 17, and the polyimide resin cladding layers 18a and 18b is carried out on the n-GaAs semi-conductor substrate 11. In the above, the p electrode 19 made from a metallic conductor is formed in the top face ranging from the contact layer 17 to the resin cladding layers 18a and 18b, and the n electrode 20 made from a metallic conductor is formed in the inferior surface of tongue of the semi-conductor substrate 11.

[0006] [Problem(s) to be Solved by the Invention] the case of the semiconductor laser component illustrated by drawing 1 -- the luminescence field LZ from -- the level transverse mode (FFP||) of the beam by which outgoing radiation is carried out, and the perpendicular transverse mode (FFP**) present distribution like drawing 3 . When it is going to obtain a monophasic outgoing radiation beam in such a semiconductor laser component, it is supposed that it is effective to make small pars-basilaris-ossis-occipitalis width of face W of the ridge slack rib mold cladding layer 16. Incidentally, although the basic transverse-mode oscillation of the case of W= 3 micrometers is carried out like drawing 6 (a), since the higher mode occurs like drawing 6 (b) in the case of W= 6 micrometers, it becomes difficult to combine this and small aperture optical waveguide with a condenser lens. It is known for this kind of technical field that the value (Wc) of W for obtaining the monophasic transverse mode will change with horizontal refractive-index distribution, and when it is a ridge and the ridge mold laser structure where an effective-refractive-index difference with the section is 1% or less in addition to this, the monophasic transverse mode is obtained in W< 4 micrometers. However, in ridge mold laser structure, it is not easy to calculate the value of Wc using the refractive index corresponding to the oscillation wavelength of a laser component in practice, though this is possible, and the validity of the calculated value also becomes a problem.

[0007] Furthermore, in the semiconductor laser component like drawing 1 , even if a monophasic beam is obtained immediately after pouring in a threshold current, when a subsequent inrush current increases, the level transverse mode changes. This is the event which became clear in the experiment of this invention persons, and the thing of the following specifications was used as a semiconductor laser component of drawing 1 in the experiment in this case. Thickness d of this is slightly [0.2 micrometers] less than the p-InGaP up cladding layer 15, and, as for the p-InGaP rib mold cladding layer 16, the pars-

basilaris-ossis-occipitalis width of face W of this has become 3.5 micrometers. Cavity length was 1000 micrometers, the coating reflective film of 95% of reflection factors was used as a posterior part resonator mirror, and the coating reflective film of 10% of reflection factors was used as an anterior part resonator mirror.

[0008] Drawing 8 (a) and drawing 8 (b) show these current dependence properties about the level transverse mode (FFP||) of the semiconductor laser component in the above-mentioned example of an experiment, and the perpendicular transverse mode (FFP**). Though it holds monophasic [of an outgoing radiation beam] in the case of this semiconductor laser component, the core of a beam is changing about 5 degrees like drawing 8 (a) between 110-140mA of inrush currents. Drawing 7 is the optical output-current (I-L) property Fig. of the semiconductor laser component in the above-mentioned example of an experiment. In drawing 7 , a continuous line shows I-L in a free space, and the dotted line shows the output of an optical fiber edge when the semiconductor laser component concerned and optical waveguide (optical fiber with a core diameter [phi] of 8 micrometers) are combined through horizontal and vertical 2 lens systems. With reference to drawing 8 , as for the semiconductor laser component of the above-mentioned example of an experiment, a kink appears with change of the level transverse mode even in a free space, and, moreover, even the output of an optical fiber edge is declining greatly after change of the level transverse mode so that clearly. This is because the image which carried out lens condensing originated in change of the level transverse mode, and moved and the joint effectiveness of a semiconductor laser component and optical waveguide fell. Therefore, that to which monophasic [of the level transverse mode] can be held even when an inrush current is increased after that, and a beam core does not move is required not to mention immediately after impregnation of a threshold current as this kind of a semiconductor laser component.

[0009] [Purpose of invention] this invention tends to offer the semiconductor laser component which can obtain the stable transverse mode in view of such a technical technical problem.

[0010] [Means for Solving the Problem] In the semiconductor laser component equipped with the barrier layer covered by the lower cladding layer and the up cladding layer on the semi-conductor substrate, since this invention oscillates the basic transverse mode at the time of laser actuation While the up cladding layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer, the desired end is attained by being characterized by the rib mold cladding layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers having projected from the top face of an up cladding layer corresponding to the luminescence field of a barrier layer.

[0011] As an example in the above, a semi-conductor substrate consists of GaAs and a lower cladding layer, an up cladding layer, and a rib mold cladding layer consist of InGaP, respectively. A barrier layer consists of an InGaAs deformation amount child well layer as an example in the above. The barrier layer in this case may include SCH structure or GRIN-SCH structure and/or QW structure, or MQW structure.

[0012] [Function] Although the carrier in a barrier layer is consumed in a semiconductor laser component with ridge mold laser structure as everyone knows when an optical output increases with the increment in an inrush current, on the occasion of this, the level transverse mode which is the fourier change changes. Since carriers tend to decrease in number as a cause of this especially in the mesa center section where an optical consistency is high and the gain in the both sides becomes high, it is possible that a hole burning arises and that the

higher mode is excited and optical density distribution changes with change of such gain distribution.

[0013] The up cladding layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer, and the rib mold cladding layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers has projected the semiconductor laser component concerning this invention from the top face of an up cladding layer corresponding to the luminescence field of a barrier layer.

[0014] Since the higher mode becomes this makes a horizontal effective-refractive-index difference decrease, and is easy to be cut off when up clad layer thickness is 0.25-0.50 micrometers, an optical consistency decreases and a hole burning also stops being able to happen easily.

[0015] Since the higher mode is not only cut off, but impregnation of the carrier by diffusion follows to consumption of a carrier when the pars-basilaris-ossis-occipitalis width of face of a rib mold cladding layer is 2.0-3.5 micrometers, a hole burning stops being able to happen easily. Therefore, in the case of the semiconductor laser component concerning this invention, the level transverse mode cannot change but the stable transverse mode can be obtained.

[0016] [Example] The fundamental configuration of the semiconductor laser component concerning this invention is the same as that of what was illustrated by drawing 1 . Namely, the semiconductor laser component concerning this invention In the n-GaAs semi-conductor substrate 11 top The n-InGaP lower cladding layer 12, The barrier layer 13 which consists of an InGaAs deformation amount child well layer, and the GaAs etching stop layer 14, The p-InGaP up cladding layer 15 and the p-InGaP rib mold cladding layer 16, The p-GaAs contact layer 17 and polyimide resin cladding layer 18a, Sequential formation of the 18b is carried out, and the p electrode 19 made from a metallic conductor is formed in the top face ranging from the contact layer 17 to the resin cladding layers 18a and 18b, and the n electrode 20 made from a metallic conductor is formed in the inferior surface of tongue of the semi-conductor substrate 11. With reference to drawing 2 , the barrier layer 13 in the above includes the GRIN-SCH structures 13a and 13b which consist of InGaP so that clearly.
[0017] As stated above, the semiconductor laser component concerning this invention is in within the limits whose thickness d of the up cladding layer 15 is 0.25-0.50 micrometers, and is in within the limits whose pars-basilaris-ossis-occipitalis width of face W of the rib mold cladding layer 16 is 2.0-3.5 micrometers. Incidentally, about the level transverse mode of the semiconductor laser component which are d= 0.3 micrometers and W= 2.7 micrometers, if the current dependence property of this is shown, it will become like drawing 4 . As for a semiconductor laser component (d= 0.3 micrometers and W= 2.7 micrometers), the beam of this holds monophasic so that clearly with reference to drawing 4 , and the core of a beam is not changed, either.

[0018] The example of an experiment for next checking the effectiveness of the semiconductor laser component concerning this invention is explained. As a semiconductor laser component like drawing 1 , the following table makes d and W a parameter, builds various things, and shows the probability for the semiconductor laser component by which the beam was stabilized in 50 or more evaluation element numbers, respectively to be obtained, and the probability for the component which sets by 200mA of inrush currents, and does not more specifically have fluctuation in a beam core to be obtained.

[0019] W**d 0.10 micrometers 0.15 micrometers 0.20 micrometers 0.25 micrometers 0.30 micrometers 2.0 micrometers 0.05 0.05 0.20 0.80 0.75 2.5 micrometers - zero - zero 0.05 0.80

0.80 3.0micrometer- 0 - 0-0 0.500.60 3.5 micrometers -- -- - 0 0.30 0.40 4.0 micrometers -- -- -- 0.10 0.10 [0020] With reference to the above-mentioned table, in the case of the semiconductor laser component for which d> 0.25 micrometers and W<=3.5 micrometers are satisfied, the transverse mode stabilized in the high probability can be obtained so that clearly.

[0021] The semiconductor laser component concerning this invention is producible using a photolithography technique including the selective etching process for the crystal growth technique like an epitaxial grown method, and mesa formation etc. In this case, since d can be controlled by thickness control level (about **3%) of crystal growth and W can be controlled by system level (about **0.1 micrometers) of a photo mask, the dependability of the data shown in said table is high.

[0022] Drawing 5 is the I-L property Fig. of the semiconductor laser component concerning this invention, a continuous line shows I-L in a free space, and the dotted line shows the output of an optical fiber edge that said drawing 7 described similarly. With reference to drawing 5 , a kink does not appear but, as for the semiconductor laser component concerning this invention, the high integrated state of a semiconductor laser component and an optical fiber is obtained for the free space and the optical fiber edge so that clearly.

[0023] The semiconductor laser component concerning this invention is not limited to what was illustrated by drawing 1 . For example, the technique of this invention is effective also with the semiconductor laser component in which a barrier layer includes SCH structure and MQW structure. In addition, with an insulator (dielectric), if the cladding layers 18a and 18b in this invention semiconductor laser component have a refractive index smaller than InGaP, things other than polyimide resin can also be used for them. As an example of this, the compound semiconductor like AlInGaP can be raised to SiO2, SiNx, aluminum 2O3, general synthetic resin, and a pan.

[0024] [Effect of the Invention] Since the rib mold cladding layer with a pars-basilaris-ossis-occipitalis width of face of 2.0-3.5 micrometers has projected this invention from the top face of an up cladding layer corresponding to the luminescence field of a barrier layer while the up cladding layer with a thickness of 0.25-0.50 micrometers is left behind to the upper part of a barrier layer in order to oscillate the basic transverse mode in a ridge mold semiconductor laser component at the time of laser actuation, it can obtain the stable transverse mode.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view having shown one example of this invention semiconductor laser component.

[Drawing 2] It is drawing which sketched the GRIN-SCH structure of the barrier layer in this invention semiconductor laser component with the bandgap energy of this, and thickness.

[Drawing 3] It is the transverse-mode distribution map of the laser beam in this invention semiconductor laser component.

[Drawing 4] It is the current dependence property Fig. of the level transverse mode in this invention semiconductor laser component.

[Drawing 5] It is the optical output-current characteristic Fig. of this invention semiconductor laser component.

[Drawing 6] It is drawing having shown the level transverse mode immediately after threshold-current impregnation about each semiconductor laser component (W= 3 micrometers and W= 6 micrometers).

[Drawing 7] It is an optical output-current characteristic Fig. in the existing semiconductor laser component.

[Drawing 8] It is drawing having shown these current dependence properties about the level transverse mode in the existing semiconductor laser component, and the perpendicular transverse mode.

[Description of Notations]
11 Semi-conductor Substrate
12 Lower Cladding Layer
13 Barrier Layer
14 Etching Stop Layer
15 Up Cladding Layer
16 Rib Mold Cladding Layer
17 Contact Layer
18a Resin cladding layer
18b Resin cladding layer
19 P Electrode
20 N Electrode